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The influence of quality of life on urban growth. A case study of Barcelona

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Abstract

There are several determinants that influence household location decisions. More concretely, recent economic literature assigns an increasingly important role to the variables governing quality of life. Nevertheless, the spatial stationarity of the parameters is implicitly assumed in most studies. Here we analyse the role of quality of life in urban economics and test for the spatial stationarity of the relationship between city growth and quality of life.

Keywords: quality of life, urban economics, city growth, geographically weighted regressions

Vicente Royuela, Rosina Moreno and Esther Vayá 生活质量对城市增长的影响，以巴塞罗那为例，区域研究。有很多决定性因素影响家庭置业的区位选择。在目前的经济文献中更是更为具体地强调了决定生活质量的相关变量的重要性。然而，参数的空间固定性依然是大多数研究中都明确提出的假设前提。本文中我们分析了生活质量在城市经济以及测评城市增长与生活质量间相互关系的空间固定性方面所扮演的角色。

生活质量　城市经济　城市增长　地理回归值

L'impact de la qualité de la vie sur la croissance urbaine.

Royuela et al.

Nombreuses sont les déterminants du choix d'emplacement des ménages. Essentiellement, la documentation économique récente accorde un rôle de plus en plus important aux variables qui déterminent la qualité de la vie. Néanmoins, la plupart des études supposent implicitement une géographie stationnaire des paramètres. On cherche à analyser le rôle de la qualité de la vie dans l'économie urbaine et on fait des analyses pour déceler la géographie stationnaire du rapport entre la croissance urbaine et la qualité de la vie.

Qualité de la vie / Economie urbaine / Croissance urbaine / Régressions géographiques pondérées

Der Einfluss der Lebensqualität auf das Wachstum von Städten. Eine Fallstudie von Barcelona

Vicente Royuela, Rosina Moreno and Esther Vayá

Abstract

Die Entscheidung für den Standort von Haushalten wird von mehreren Determinanten beeinflusst. Insbesondere wird in der aktuellen Wirtschaftsliteratur den für die Lebensqualität ausschlaggebenden Variablen ein zunehmend hoher Stellenwert eingeräumt. Allerdings wird in den meisten Studien für diese Parameter implizit eine räumliche Unveränderlichkeit angenommen. In diesem Beitrag analysieren wir die Rolle der Lebensqualität in der Ökonomie von Städten und überprüfen die räumliche Unveränderlichkeit der Beziehung zwischen Stadtwachstum und Lebensqualität.

Keywords:
Lebensqualität
Ökonomie von Städten
Stadtwachstum
Geografisch gewichtete Regressionen

La influencia de la calidad de vida en el crecimiento urbano. Estudio del caso de Barcelona

Vicente Royuela, Rosina Moreno and Esther Vayá

Abstract

La decisión de elegir el lugar de la vivienda depende de varios factores determinantes. En concreto, la reciente literatura económica asigna un papel cada vez más importante a las variables que gobiernan la calidad de vida. Sin embargo, en la mayoría de estudios se supone implícitamente la estacionalidad espacial de los parámetros. Aquí analizamos el papel de la calidad de vida en la economía urbana y comprobamos la estacionalidad espacial de la relación entre el crecimiento de las ciudades y la calidad de vida.

Keywords:
Calidad de vida
Economía urbana
Crecimiento de las ciudades
Regresiones ponderadas geográficamente

JEL: R00, E00

1. Introduction

In economic terms, urban areas exist due to the presence of externalities related to the higher productivity that agents could achieve by being close to other producers or market agents. Thus, it can be stated that cities are the most economically efficient way of spatially distributing relationships between individuals. The basis for this higher efficiency is the existence of scale economies: more efficient processes can only be developed when a minimum scale is achieved, even if this only occurs in one economic sector, which justifies the urban growth processes observed in the last decades, particularly in developed countries. Nevertheless, several constraints affect the growth of cities, which are basically related to congestion, environmental quality, criminality and other factors. Therefore, agglomeration economies can, beyond a critical point, degenerate into agglomeration diseconomies.

We also believe that decisions to move households from place to place, thereby generating the urban growth processes highlighted above, are not strictly based on economic or monetary motives. On the contrary, a key assumption in our study is that the physical and social environment can also influence the economic behaviour, happiness and collective well-being of individuals. This mechanism can be labelled as both objective and subjective and is influenced by psychological and physiological aspects. From an economic perspective, the work of TIEBOUT, 1956, is a classic reference, in which voters-consumers decide where to locate their household on the basis of where they can gain the best quality of life. It could, then, be concluded that among the factors taken into account by individuals when deciding to migrate, the quality of life offered in a given town or city is a clear determinant (ROGERSON, 1999; CAPELLO and CAMAGNI, 2000). Here we understand quality of life as the degree to which a person's life is desirable versus undesirable, with an emphasis on external components, such as environmental factors and income (DIENER, 2006).

Additionally, if we consider the spatial dimension, for example different locations within a metropolitan area, it is sensible to think that social and environmental conditions are different in locations that are further from the metropolitan centre. Thus, we could expect different types of response to the same variables. TÜRKSEVER and ATALIK, 2001, with the aim of examining methods for measuring quality of life with respect to regional variations, regress the subjective perceptions of quality of life of individuals against a series of variables related to different objective dimensions of quality of life. They determine that the dimensions of health, climate, crowding, sport, housing conditions, journey to work and environmental pollution are major determinants of the satisfaction level in sample districts from the Istanbul metropolitan area. However, a number of districts show higher coefficients of determination depending upon a number of different independent variables. Consequently, it is one of the first studies in which we find spatial differences in the utility functions of households within a metropolitan area.

Within the framework of the urban economic literature, we can think of several possible reasons for the spatial differences in the utility functions of household. First, the economic function of every city in a national network of cities is a clear example of the specialization of cities in the urban hierarchy, which might lead to a situation in which each kind of city carries out different functions. The well-known rank size rule is a clear example. Another reason is the separation of the space between urban and rural areas, which may lead to very different spatial and sectoral specializations.[1] For all these reasons, certain variables related to quality of life may have a different impact on the growth of the cities, according to their characteristics and role, which at the same time may be related to their spatial location.

Assuming the former scenario, this paper addresses two main objectives. Firstly, we are interested in determining the extent to which quality of life is a relevant factor in the explanation of urban growth, while controlling for more traditional determinants. We will analyse which of the issues related to quality of life are most influential in urban growth. Secondly, we will test whether the responses of individuals to different levels of quality of life present the same magnitude across the studied territory. In other words, we intend to analyse whether the effect of quality of life on city growth can be considered stable over space or, on the contrary, whether this effect varies with the territory considered. And, if it were the case, which possible reasons can be behind that behaviour. According to the latter theory it would be necessary to consider the possibility that the response of urban growth to changes in quality of life is different according to the situation of the city in the territory. One way of modelling this issue is to use geographically weighted regression (GWR) techniques. The empirical work is applied to the narrower official territorial division within a province, specifically the 314 municipalities in the province of Barcelona.[2]

The paper is structured as follows. The following section describes the determinants of city growth, with a particular focus on quality of life, and describes the theoretical model on which we base our study. Section three presents the empirical framework and briefly describes the GWR techniques. Data and descriptive analyses of the province of Barcelona are given in section four. Section five contains the econometric results and section six concludes the study.

2. The model

2.1. The determinants of city growth

Urbanisation is a phenomenon that has intensified in the last decades due to the advantages of agglomeration associated with size. Agglomeration economies are the key factor in offering higher incomes to city households. However, once a certain size is reached, the generation of negative externalities such as congestion and commuting costs suggests the existence of an optimal city size above which any further increase in physical dimensions reduces the advantages of agglomeration (HENDERSON, 1974). As suggested in RICHARDSON, 1972, a noticeable paradox exists between the theoretical notion of an "optimal city size" and the fact that big cities continue to expand in developing countries. The explanation given by Richardson is based on the existence of determinants other than physical size that influence urban agglomeration economies.

As stated in CAPELLO and CAMAGNI, 2000, the literature has identified determinants of urban location advantages other than urban size, such as the type of economic function developed by the urban centre, its spatial organisation and the efficiency of its internal structure. Some studies have explicitly considered the growth of cities and emphasise the role of the *urban attributes* as determinants of the attractive power of an area. References have been made to climatic variables, aesthetic elements, the presence of public goods and services, local government policies (taxes or benefits) and social interactions (GLAESER *et al.*, 2001; GLAESER and KHAN, 2003; CHESIRE and MAGRINI, 2006; and SHAPIRO, 2006). The importance of these attributes in determining the competitive capacity of territories is related to strictly economic factors, such as the GDP per capita.

The relevance of the specific attributes of each location varies according to the purpose of each study and whether the analysis focuses on sustainable urban growth (the advantages of agglomeration versus dispersion/sprawl) or inter-urban competition. In his discussion of the advantages of cities as urban agglomerations, GLAESER, 2000, highlights the role of what he calls "non-market forces" in achieving urban growth: the flow of ideas among enterprises, human capital spillovers, social capital or peer effects. In a subsequent study, GLAESER *et al.*, 2001, discuss the advantages that cities – as spatial agglomerations – have to offer and link them with the importance of urban amenities as a crucial factor that can determine urban viability and growth. The underlying hypothesis is that the large agglomerations that offer these types of advantages are viable, whereas others could potentially face serious decline. These advantages constitute what the authors call the "urban amenity", which can be viewed as a desirable package of goods demanded by the "consumers" of an urban space. FLORIDA, 2002, discusses the importance of high quality goods and services – referring to them as "quality of place" – in attracting highly-skilled labour in US cities. Following the growth models of Lucas and Romer, the underlying assumption is the importance of knowledge and human capital in generating economic growth. In this context, Florida underlines the importance of quality of life variables as the driving forces behind the location decisions of the highly-skilled labour force.[3] It therefore seems plausible to conclude that, in addition to the economic factors that are important in explaining urban growth, a good quality of life is also a dominant factor.

Recently, quality of life has become a commonly used term among researchers working in different fields. Specifically, it has been viewed as part of the profile of a competitive city, i.e. one that is successful in attracting capital, as well as being a determining factor in patterns of urban growth. Of the different surveys in the literature aimed at interpreting the motivations for moving among recent migrants, quality of life is raised as one of the reasons considered (ROGERSON, 1999). For example, in the study carried out by FINDLAY and ROGERSON, 1993, quality of life is important to more that 70 per cent of the migrants interviewed and is considered more important than employment opportunities, living costs or family ties. From the perspective of urban planners, cities are the centre of economics, politics, commerce and other activities, so it is necessary to analyse the conditions that contribute to the quality of urban life.

2.2. The model

The basic model is the one developed in GLAESER et al (1995). There, cities are treated as separate economies that share common pools of labour and capital, which are assumed to be mobile. Consequently, cities differ only in terms of the level of productivity and the quality of life. Total output is given by:

$$A_{i,t} f(L_{i,t}) = A_{i,t} L_{i,t}^{\sigma} \qquad (1)$$

where $A_{i,t}$ is the level of a broad definition of productivity in city i at time t, $L_{i,t}$ denotes the population of city i at time t, $f(.)$ is a common across-cities Cobb-Douglas production function, and σ is a nation-wide production parameter. The labour income of a potential migrant will be:

$$W_{i,t} = \sigma A_{i,t} L_{i,t}^{\sigma-1} \qquad (2)$$

This potential migrant will have a total utility that equals wages multiplied by a quality of life index (QoLi,t), which is assumed to be declining according to the size of the city:

$$QoL_{i,t} = Q_{i,t} L_{i,t}^{-\delta}\,, \tag{3}$$

where δ>0, and where $QoL_{i,t}$ captures a wide range of factors related to crime, housing prices, and traffic congestion, among others. Total utility of individuals equals wage multiplied by a function of the quality of life index:

$$Utility = \sigma A_{i,t} L_{i,t}^{\sigma-1} QoL_{i,t}^{\delta} = \sigma A_{i,t} L_{i,t}^{\sigma-\delta-1} Q_{i,t} \tag{4}$$

Free migration across cities is assumed. Consequently, there is a constant utility across space (spatial equilibrium) at a point of time, $U_{i,t} = \underline{U}_t$. Thus, for each city:

$$\log\left(\frac{\underline{U}_{t+1}}{\underline{U}_t}\right) = \log\left(\frac{A_{i,t+1}}{A_{i,t}}\right) + \log\left(\frac{Q_{i,t+1}}{Q_{i,t}}\right) + (\sigma-\delta-1)\log\left(\frac{L_{i,t+1}}{L_{i,t}}\right) \tag{5}$$

Changes in productivity and quality of life are assumed to be a function of a vector of city characteristics at time t, $X_{i,t}$:

$$\log\left(\frac{A_{i,t+1}}{A_{i,t}}\right) = X_{i,t}^{'}\beta + \varepsilon_{i,t} \tag{6}$$

$$\log\left(\frac{Q_{i,t+1}}{Q_{i,t}}\right) = X_{i,t}^{'}\theta + \zeta_{i,t} \tag{7}$$

Combining (5) with (6) and (7), the following equation is obtained:

$$\log\left(\frac{L_{i,t+1}}{L_{i,t}}\right)=\frac{1}{1+\delta-\sigma}X_{i,t}^{'}\left(\beta+\theta\right)+\chi_{i,t} \tag{8}$$

Where $\chi_{i,t}$ include any factor influencing quality of life or productivity growth, but not considered in the vector of city characteristics $X_{i,t}$. In this model cities will *increase* their population if they experience an increase in the factors that influence positively both productivity and quality of life, the final drivers of population migration. The results of the model can be interpreted as showing how the city level variables (X) determine the growth of the city population, through the growth of productivity and quality of life. In this model no reverse causality can arise, as the dependent variable is an approximation of a growth rate between t and $t+1$, based on the conditions at time t. Of course, this behaviour is expected for a standard household, without any particular life cycle circumstances.[4]

The grounds of this model do not lead us to expect any spatial non-stationarity in its parameters. Consequently, it might be the result of the violation of some assumptions of the model. First, the production function of every city, *f(.)*, may not be not equal, due to, for instance, different specializations in the territory. Second, the utility function of individuals in the territory may diverge. Although we do not expect this to happen, we have to admit that we can see residential segregation within a city or a metropolitan area, which could lead us to expect different behaviours of different people. Third, we might find spatial non-stationarity if there is a lack of free migration across territories. If, for any reason, this assumption does not hold, then there can be no spatial equilibrium and no constant utility across space. The economic forces driving this situation are similar to those that cause the existence of housing submarkets: inefficiencies in the housing market, and the special characteristics of the good, such as spatial fixity, durability, and so on. For these reasons, certain variables related to quality of life might have a different impact on the growth of the cities, according to their characteristics and role, which at the same time could be related to their location in the space.

2.3. Defining quality of life

Although the list of specific issues to be included in a definition of quality of life varies between studies, there is a consensus over factors such as the physical environment, housing, climate, pollution or social facilities linked to education and health. Nevertheless, the agreement is not so clear for the alternative ways of conceiving quality of life. It has been argued that perception and experiences of quality of life are becoming important in the spatial decision-making of individuals. There is not, however, a single way in which quality of life should be measured. As a measured variable, quality of life would be determined by both the subject and the object of inquiry, which would lead to either a perceptual or an objective perspective.

Much of the early research on quality of life (CAMPBELL *et al*., 1976; ANDREWS and WITHEY, 1976, among others) understood it at the individual level and considered how personal characteristics and views shape the quality of life of a given individual (perceptual perspective). Under this conception, our notion of quality of life is that of the degree of satisfaction or dissatisfaction with aspects of our lives. Research considering personal aspects categorised quality of life either as satisfaction scales or via responses to surveys and interviews about the immediate experience and well-being of respondents (ROGERSON, 1999).

More recent research is devoted to the concept of quality of life as related to places and their characteristics (objective perspective). Under this view, quality of life is influenced by the environment in which people live (HELBURN, 1982), so any assessment of quality of life should consider the extent to which the necessary conditions for personal satisfaction and happiness are achieved, i.e. those attributes of the environment that stimulate satisfaction. Studies that focus on locations and their characteristics tend to select the attributes and characteristics through expert or other non-survey approaches, such as econometric and revealed preference methods (e.g. BERGER *et al*., 1987; STOVER and LEVEN, 1992).

Most economists do not explicitly assume a certain definition of quality of life. Rather, they simply consider different indicators potentially influencing quality of life, such as climate variables (CHESIRE and MAGRINI, 2006) or the number of bars and restaurants in an area (GLAESER *et al*., 2001). Here we will assume a definition given recently by a group of academics from the International Society for Quality of Life. They define quality of life in the following way: “it usually refers to the degree to which a person’s life is desirable versus undesirable, often with an emphasis on external components, such as environmental factors and income. In contrast to subjective well-being, which is based on subjective experience, quality of life is often expressed as more *objective* and describes the circumstances of a person’s life rather than his or her reaction to those circumstances” (DIENER, 2006, p. 4). Therefore, as will be presented in Section 4, in this paper we will measure the factors influencing quality of life by using a set of indicators consisting of goods, services and other attributes related to the social, physical and economic environment of the places where people live.

3. Data and empirical model

3.1 Geographical scope

As mentioned above, the first objective of this paper is to determine to what extent quality of life is a relevant factor in the explanation of urban population growth. As indicated by GLAESER *et al.*, 1995, this measure might not be accurate at the national level, since the population is relatively immobile, whereas at the local level population growth reflects whether cities are becoming gradually more attractive to the population.

The analysis focuses on the province of Barcelona, one of the four provinces in the region of Catalonia. Catalonia (NUTS II in the European administrative classification) is a highly industrialized region located in the north-east of the country and is one of Spain's most developed regions. It is divided into four administrative provinces (NUTS III in the European administrative classification). Barcelona is the most populated of these provinces, with 76% of the region's inhabitants. Its population rose from 4,655,853 in 1991 to 4,737,695 in 2000, an increase of 1.7% in the decade. Together with Madrid, Barcelona is the most populated and urbanized Spanish province. The province is similar to other areas in Europe in that it contains a large city with a relatively wide area of influence, comprising its suburbs, the surrounding towns, industrial clusters, and so on.[5]

We assume that in many developed countries city size is now mainly related to migration and that this migration occurs more frequently within metropolitan areas than between them. Consequently, for a relatively short period of ten years, a narrower territorial scope is more appropriate. In addition, in Spain these local migrations are much more frequent than long-distance migrations. Of course, we assume that the critical factors affecting these short-distance migrations are different to those affecting long-distance migrations (migrations between metropolitan areas). In any case, this point does not invalidate our procedure and actually stimulates future studies of other territorial dimensions. Consequently, as our basic unit of analysis we used municipalities, the smallest one available.

The province of Barcelona has 314 municipalities (NUTS V in the European administrative classification), which we established as the basic unit of measurement in our study. This administrative definition of the unit of analysis is usually a part of a wider city. In other words, *real* cities usually take in more than just one municipality. Nevertheless, several municipalities, usually the smaller ones, are isolated from the rest, and do not display an urban continuum. Consequently we are assuming a small unit of analysis which, of course, will be connected though commuting relationships, belonging to the same local labour markets, and so on.

Focusing our analysis in the province of Barcelona is particularly interesting given the high heterogeneity of the characteristics of the municipalities that make it up. In addition to the highly industrialized area of influence around the city of Barcelona, the province has a long coastline, which, together with a mild climate, has helped the municipalities on the coast to attract a large population influx over recent decades. This has been accompanied by a group of inland municipalities, some way from the central business area of Barcelona, close to the Pyrenees, which are mainly active in agriculture. Given this heterogeneity within a relatively small area, one would expect non-spatial stationarity in the response in the impact of quality of life on urban growth.

3.2 Empirical model

With the aim of analysing whether quality of life is a determinant of urban growth, we estimate a model in which population growth in a municipality is a function of several indicators of quality of life. However, following the literature surveyed in the previous section, we will control for the impact of issues such as population in the initial year, the different functions and specializations played by the municipalities, its network of integration with the rest of the world, and the distance from the main cities. Specifically, we estimate the following growth equations:

$$\ln(POP_{iT} / POP_{i0}) = \beta_0 + \beta_1 \ln POP_{i0} + \beta_2 FUNSYS_{i0} + \beta_3 FUNSUB_{i0} + \beta_4 \ln TELEPH_{i0} + \\ + \beta_5 \ln DBCN_{i0} + \beta_6 \ln DSYS_{i0} + \beta_7 \ln DSUB_{i0} + \beta_8 \ln CQLI_{i0} + \varepsilon_{iT} \quad (9)$$

where the dependent variable is the population increase in each local area between 1991 and 2000, measured in terms of the log of the population ratio (a measurement that approximates the growth rate). The independent variables are described below.

ln POP is the log of the population in 1991, and the remaining explanatory variables represent different urban characteristics that act as proxies for the type of economic functions developed by the urban centre, the integration of the city in the network of urban systems (i.e. the spatial organisation of the centre) and the quality of life in the city.

Concretely, the economic functions that characterise the city are important determinants of its size. As stated in HENDERSON, 1996, cities are different to one other: they are characterised by different functions and perform different specialisations. This may allow the development of economies of scale even in relatively small cities. In our empirical analysis, the function of each city is controlled by a dummy variable that is set at 1 for cities with a minimum amount of basic services, such as health and education services. Two different levels of "higher function" cities are examined. Thus, from the initial 314 municipalities we chose 24 that act as central cities (FUNSYS) and 48 that are basic functional cities (FUNSUB). These dummies are considered as cumulative to give a threshold effect.

The logic behind the network city paradigm is that the spatial organisation in which cities operate is vital to understanding their growth. This is related to long-run competition and cooperation irrespective of the distance barrier (CAMAGNI, 1993). The level of network integration of the city with the rest of the world is approximated using an indicator of the telephone lines installed in 1996, as in CAPELLO and CAMAGNI, 2000: specifically, the log of installed telephone lines per 1,000 inhabitants (ln TELPH).[6]

Since cities exist in an inter-urban environment, we also consider the possible influence of spatial interactions. We therefore computed the time measured in minutes that a person needs to travel by car to the capital of the province, that is, Barcelona city (ln DBCN), to the nearest central city (ln DSYS), and to the closest functional city (ln DSUB).

Finally, quality of life is proxied by an aggregate measurement, ln CQLI, which is the log of the Composite Quality of Life Index. Following previous work (ROYUELA *et al.*, 2003), in which a list of factors influencing quality of life was grouped into a composite index of quality of life (CQLI), built for the 314 municipalities, based on the structure of the classical study of LIU, 1973, 1978, for the USA. Here we use the same extensive database[7] with 17 basic quality of life components and three main quality of life components (see Table 1).[8] We use 17 indices that were constructed after the use of a large number of basic indicators, producing an intermediate structure of three indicators, related to the Individual Opportunities for Progress (IOP), the Social Equilibrium (ISE) and the Community Conditions of Life (CCL). All 17 indices are defined in positive terms (the higher, the better). In order to summarize quality of life in a single figure, an average index is constructed and weighted after explicit agreement between policymakers.[9] As mentioned above, the territorial scope of our analysis is the local level, and particularly municipalities. ROYUELA et al., 2003 explicitly treats the information needed to account for the spatial relationships between the municipalities. For instance, in order to consider the fact that the provision of public goods is not homogeneous in space, a spatial filtering method was used, in order to assign the level of hospital services that is available in a municipality that is 30 km away from the health centre.

Taking into account the three components of the aggregate measurement of quality of life, besides model (9), we also estimate a model where we consider the qualitative characteristics of the urban environment in a more disaggregated way:

$$\begin{aligned}\ln(POP_{iT}/POP_{i0}) = {} & \beta_0 + \beta_1 \ln POP_{i0} + \beta_2 FUNSYS_{i0} + \beta_3 FUNSUB_{i0} + \beta_4 \ln TELEPH_{i0} + \\ & + \beta_5 \ln DBCN_{i0} + \beta_6 \ln DSYS_{i0} + \beta_7 \ln DSUB_{i0} + \beta_8 \ln IOP_{i0} + \beta_9 \ln ISE_{i0} + \beta_{10} \ln CCL_{i0} + \varepsilon_{iT}\end{aligned} \tag{10}$$

Where, instead of the ln CQLI, the log of the Composite Quality of Life Index, we consider its three components: ln IOP represents the log of the Individual Opportunities of Progress index; ln ISE is the log of the Index of Social Equilibrium index; and finally, ln CCL is the log of the Community Conditions of Life index.

Two considerations are in order. Firstly, all the explanatory variables except ln TELPH, refer to the initial year under consideration, 1991. And secondly, this definition of quality of life explicitly considers the individual characteristics of the inhabitants, such as the age, wealth, educational levels, and so on. This point, which clearly affects the quality of life of households, is important when we think of patterns over the life cycle or the aspirations that different types of households have to different bundles of amenities.

3.3 Non-stationarity analysis in the impact of quality of life on urban growth

Although the first purpose of this paper is the analysis of the impact of quality of life on city growth while controlling for the more traditional determinants, our second objective is to determine whether the effect of quality of life on city growth can be considered stable over space or whether it varies with the territory studied. From an econometric perspective, this would mean that the average value for the relationship obtained in a regression may not be representative of any particular situation. Further, this could make it necessary to consider the possibility that the response of urban growth to changes in quality of life could vary according to the location of the city in the territory. Besides the economic reasons for the existence of non-stationarity, there are some others coming from an econometric point of view. The first is the sampling variation: we do not expect to obtain exactly the same results simply by virtue of having different samples across space. The second explanation is that the model from which the relationship is estimated is a poor reflection of reality and that important variables are omitted. And a third reason is that some relationships are intrinsically different over space, as we pointed out in our presentation of the model in section 2.2. Whatever the reason, if non-stationarity holds, we need to model this issue: if such a process is analysed using a global traditional estimation, the results can be locally misleading.

Various econometric methods can be used to tackle this issue. One of most popular ones is the Expansion Method (CASETTI, 1972, JONES and CASETTI, 1992), where the original parameters of the model are allowed to vary over geographic space (for instance the coordinates of the observations). This method has played an important role in promoting awareness of spatial non-stationarity. Nevertheless, several limitations arise: the spatial variation is restricted to the complexity of the spatial expansion, which has to be assumed *a priori*. Besides, the expansion is assumed to be deterministic, in order to avoid estimation problems. Other methods that account for spatial non-stationarity of the parameters are moving-window regressions, spatially adaptative filtering, multilevel modelling, random coefficient models, kernel regressions, spatial regression models, drift analysis of regression parameters, and also the one that we will concentrate on here Geographic Weighted Regressions (GWR). Of course, none of the methods are above criticism, certainly not GWR. Nevertheless, as the aim of our paper is not to let these models compete, we decided to use only one technique, GWR, based on its flexibility and the use of understanding of the outputs. Next we describe the basic principles of the technique.

The econometrics of the GWR can be followed in FOTHERINGHAM *et al*., 2002.[10] If we consider a global regression model:

$$y_i = \beta_0 + \sum_k \beta_k x_{ik} + \varepsilon_i \tag{11}$$

then GWR extends this framework by allowing local rather than global parameters to be estimated. The model is rewritten in the following way:

$$y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)\, x_{ik} + \varepsilon_i \tag{12}$$

where (u_i, v_i) denotes the coordinates of the ith point in space and $\beta_k(u_i, v_i)$ is a realisation of the continuous function $\beta_k(u,v)$ at point i. We then allow a continuous surface of parameter values and measurements of this surface are taken at certain points to denote the spatial variability of the surface. The calibration of Equation (12) is particularly problematic as there are more unknowns than observed variables. The general method to solve this problem is to assume that the coefficients are not strictly random, but rather deterministic functions of other variables, in our case, location in space. Although it is not possible to obtain unbiased estimates of the local coefficients, estimates with only a small amount of bias can be obtained, always taking into account that there is a trade-off between bias and standard error. The calibration is weighted such that the observations that are closer to i have a greater influence. In order to determine the bandwidth and shape of the weights, we follow the minimisation of the Akaike Information Criterion (AIC), based on the likelihood function of the estimates.

In order to test the spatial non-stationarity of a process, the global model can be compared with the GWR model through an ANOVA analysis, where the null hypothesis is that the global model holds and that the GWR model represents no improvement over a global model. Additional tests concerning the local parameter estimates can be conducted using a Monte Carlo test. The comparison between the observed statistic and that obtained from a large number of randomised distributions can form the basis of the significance test. Therefore, the lower the probability associated with this statistic, the more confident we can be that the process generating the local parameter estimates is non-stationary.

4. Results

4.1 Descriptive analysis

Figures 1 and 2 show the maps of population growth between 1991 and 2000 and the population level in 1991, respectively. Figure 3 shows the map of the CQLI measurements of quality of life. Additionally, Figures 4 to 6 show the quality of life components (IOP, ISE and CCL). The descriptive statistics for all variables included in the empirical models are shown in Tables 2 and 3.

As can be seen in the Figures and in Table 3, there is no clear negative correlation between the size of the municipality (in terms of population) at the beginning of the studied period and its corresponding growth rate. Although it is true that those municipalities with larger populations in 1991 (including Barcelona) generally showed lower increases (which suggests the possible presence of negative externalities derived from higher levels of saturation and congestion), the opposite effect was not generally observed in those municipalities with smaller populations at the beginning of the period. In fact, the greatest population growths were observed in various municipalities located both in coastal areas (with the exception of Barcelona and the immediate surrounding area) and in the first and second rings around the capital. In contrast, inland municipalities in the northern part of the province that had low population levels in 1991 showed low growth rates over the ten-year period analysed.

Table 3 also shows a certain positive relation between population growth and quality of life. Therefore, it appears that the municipalities with high values for the Composite Quality of Life Index (CQLI) at the beginning of the period recorded high growth rates, and vice versa. This result can also be extended to two of the three components that make up the composite index: individual opportunities for progress (IOP) and social equilibrium (ISE). In contrast, the negative correlation detected between the growth variable and the Community Conditions component (CCL) was unexpected. It therefore appears that the municipalities with the highest provision of services at the beginning of the period did not attract a significant number of new inhabitants and in fact recorded low growth rates. In order to understand this result it should be considered that the total services in the community are relative to the population size so that, in addition to Barcelona, the municipalities with smaller populations, particularly those located in the north of the province, show the greatest provision of services relative to population size. As a result, the greater distance from the centre of the province and the fewer individual opportunities for progress (shown in Figure 4) could far outweigh the advantages of these municipalities in terms of relative provision of services. In addition, this negative correlation between the growth and CCL variables could also be influenced by the situation of the Barcelona city municipality, which, as the capital of the province, contains a considerable proportion of its services but which also showed a net decrease in population between 1991 and 2000 (as was the case in most large provincial capitals).

4.2. Empirical evidence

The results of the estimates of the empirical models (9) and (10) are displayed in Table 4. In this equation the growth in cities is regressed against the population size, the functional position of each city in the urban environment, the network economies, the distance from Barcelona, the distance from the nearest functional city and finally the measure of quality of life. Columns (a) and (b) consider the composite measurement of quality of life. Columns (c) and (d) consider quality of life with the three main components included separately and without constructing a composite index. Columns (b) and (d) display the estimates with only significant variables.

In the first and second columns of every regression we show the estimates and the t-statistics of the global regression parameters. The third column displays the p-values of the Monte Carlo test in order to determine whether the local parameter estimates are stationary (null hypothesis) or non-stationary (alternative hypothesis). We also give a list of statistics for every regression: AIC, R^2 and adjusted R^2. Finally, an ANOVA test is performed in order to test the hypotheses that the global model holds and the GWR model represents no improvement over the global model.

We first comment on the results of the model using the global measure of quality of life. In columns (a) and (b) it can be seen that the goodness of fit of the model is approximately 38%. Although most variables are significant, we observe that those related with the functions of municipalities with a second order function in the system are clearly non-significant. The significant variables display the expected signs: larger cities show a lower population increase, which would imply a convergence towards a steady state of city size; the network economies variable is positive and very significant; the distance of the municipalities from Barcelona or from the first order function cities has a negative influence, which would lead to intense suburbanisation of the main cities. Finally, the quality of life variable is clearly significant and positive, which implies that well-being is a relevant factor in the explanation of urban population growth, after controlling for more traditional determinants. Consequently, the CQLI measures a list of factors that influence the growth of quality of life, and subsequently induces the population growth of the municipalities.

Columns (c) and (d) of Table 4 present the estimates of the model using the three main components of quality of life instead of the composite index. The global adjustment is clearly improved, with an R^2 of 0.48. This is a key result: composite measurements can lead to worse adjustments. The same signs and significances as in the former estimates are observed, so the main conclusions are maintained. As for the quality of life parameters, they display very different results. We observe that the indices of Individual Opportunities for Progress (IOP) and Social Equilibrium (ISE) have the expected positive sings and that the latter has a greater influence on city growth. In contrast, the Community Conditions of Life (CCL) index shows a counterintuitive negative result, implying that municipalities initially experiencing high (low) levels of CCL display low (high) population growth rates.

Therefore, as far as the first objective is concerned, we have observed that quality of life is an important determinant of urban growth, so that those territories with higher well-being level will attract population from other locations. Besides, if disaggregated, we detect that the initial level of the individual characteristics (IOP) and the social equilibrium (ISE) have a positive influence on quality of life growth and subsequently on population growth, whereas high initial levels of community conditions of life (CCL) do not seem to reflect an increase in quality of life. Among possible explanations, we should point out that since Barcelona is a province with a high level of development in which the welfare state provides social services, individuals may attribute more importance to economic issues and their opportunity for progress than to the relatively higher provision of community conditions (schools, hospitals, transport, and so on).

So far we have considered stationarity in the magnitude of the impact of the variables in the model of urban growth throughout the territory. However, taking into account the arguments presented above on the spatial heterogeneity of the municipalities making up the province of Barcelona, we will now look at the potential non-stationarity of the parameters in the model.

In both models we find that the GWR alternatives show significantly improved goodness of fit indices: in the model with the CQLI the adjustment increases to 0.58 compared to the global model once the non-significant variables have been removed (column b), where the adjustment is 0.38. In the disaggregated quality of life model (column d) we also find a significantly better behaviour of the GWR model (0.68 versus 0.48). This better performance is due to the fact that not all variables can be seen as spatially stationary.

Specifically, we see that the intercept and the variable proxying network economies are significantly non-stationary. We also find that the result for the distance from Barcelona in the column (b) model and the distance from the closest central city in the column (d) are significantly non-stationary. To study the non-stationarity of these variables in more depth, Figures 7a and 7b show the maps of the network economies parameter and the corresponding t-statistics. It can be seen that the variable is not significant in the upper part of the map and is very significant in the coastal municipalities of the south. It makes sense that the municipalities in the upper part close to the Pyrenees, which are more isolated and have a less benign climate, should the ones where the impact of network economies on population growth is non-significant. Figures 8a and 8b show the same concepts for the variable of distance to Barcelona. We see that the variable is significant mainly in the middle distance from the capital of the province, facing moderate values

Therefore, municipalities that are closer to or very far from Barcelona are not significantly influenced: the closer municipalities because they are integrated into the real metropolitan area and the further municipalities because they are too far away from the city to be influenced. In contrast, the mid-distance municipalities are sufficiently close that they are necessarily influenced by the city but also too far away to benefit from its agglomeration economies.

Finally, we also see that quality of life variables display non-stationary behaviour, both in the composite model (column b) and in the disaggregated model (column d). Interestingly, in the latter, the only non-stationary parameter is the one related to CCL, the variable with an unexpected negative sign. Figures 9a and 9b show the maps of the parameter and the corresponding t-statistics for the CQLI, while figures 10a and 10b show the geographic parameter estimates and corresponding t-statistics for the CCL index.

Interestingly, the CQLI is not significant in the upper part of the map, in the city of Barcelona or in some of its closer municipalities. In these locations it does not seem to be a key variable in explaining the population increase. When we disaggregate the CQLI into its three components, we can see that the non-spatial stationarity of this index is due to the CCL component. The parameter of the CCL variable is not significant surrounding the city of Barcelona, showing that in the area close to the capital city variations in population are not influenced by the relative provision of services. In contrast, this parameter shows a clear negative significance to the north and to the south-west. This means that even the municipalities in those areas with relatively low (south west) or high (north) relative levels of education, health and other important types of services experience an increase (south west) or decrease (north) in population.

There are several possible explanations for the non-stationarity of all these variables and the differences detected among three geographical areas: the north of the province, the area surrounding the city of Barcelona and the south-west of the province. First, we have seen that the north of the province displays significantly differentiated parameters for several variables: the network economies variable (Figure7b), the CQLI (Figure 9b) and the CCL (Figure 10b). In view of the theoretical foundations of the model, we conclude that this part of the province shows a clearly differentiated behaviour, and probably not an equal production function. Consequently this part of the province, by far the most rural, does not belong to the same functional or economic area as the rest of the territory. Besides, specifically in the case of the sign of the CCL, although high indices of services per inhabitant can be observed (Figure 6), due to the low population density, they coincide with low population growth rates. The most plausible explanation, besides the differences in functions noted above, is that the great distance from the central business of the province and the low level of agglomeration economies exert a negative impact on urban growth which more than compensates the positive impact of better conditions in community services.

Secondly, we see a permanently differentiated behaviour of the area surrounding the city of Barcelona with respect to the parameters concerning the distance from Barcelona (Figure 8b), and the parameters concerning CQLI (Figure 9b) and CCL (Figure 10b). These parameters are not significantly different from zero for any of these variables from a local point of view. In our view, this means that the population growth of that area is not the response to the differences in the initial levels of the quality of life variables mentioned above. This means that these differences are perfectly compensated in terms of, for instance, housing prices or wages. Here, housing and/or labour markets are playing an efficient role, probably due to the existence of a large housing and/or labour market.

Thirdly, we find a differentiated behaviour of some of the parameters in the south west of the province, together with a negative sign of the parameter of the CCL index. The differentiated behaviour of the area is not related to the isolation or ruralization of this territory. Here, we interpret the non-stationarity and negative sign in terms of an imperfect functioning of the free migration assumption of the model. In this part of the province of Barcelona a highway was built at the beginning of the period under analysis, connecting the south west part of the province with the capital city. The highway crossed a mountain which had previously formed a natural barrier. This led to a sudden increase in the proximity of the metropolitan area to the centre, which in turn increased the attractiveness of the area (for example thanks to the lower housing prices in this area in contrast to the city of Barcelona) despite the low levels of common services. Here, we see low CCL levels together with high population growth rates. Consequently, an initial spatial disequilibrium caused by the emergence of a new infrastructure is slowly developing and changing the situation in the area, and thus, we could expect a negative sign in the parameter, as a consequence of the new circumstances in this area, which are not instantly cleared due to inefficiencies in the housing and/or labour markets.

5. Conclusions

This paper addresses several main points. First, we assess the influence of quality of life on household decisions, which has been neglected in most explanations of city growth. Our results for the case of the municipalities in the province of Barcelona suggest that the factors influencing the growth of cities are those that are usually suggested in the literature: urban size, network economies and distance from the centre of the metropolitan area. But as we hypothesized, quality of life also seems to play an important role.

Second, we should highlight the importance of the multidimensionality of the concept, which shows that the use of disaggregated indices of quality of life leads to better adjustments than the use of a composite indicator. Specifically, we consider three dimensions of quality of life: Individual Opportunities for Progress, Social Equilibrium and Community Conditions of Life. Interestingly, we also found that when the composite index of quality of life is disaggregated into its three main components, a better model is achieved. However, whereas the expected positive effect in city growth is obtained for two of the quality of life components of the composite indicator (Index of Opportunities for Progress and Index of Social Equilibrium), the third parameter accompanying the variable Community Conditions of Life presents an unexpected negative sign. In other words, those areas with a high/low endowment of relative educational, health and infrastructure services seem to have experienced low/high population growth rates.

Thirdly, taking into account the high heterogeneity of the characteristics of the municipalities in the province of Barcelona, within a relatively close distance, we expect non-spatial stationarity in the response in the impact of quality of life on urban growth. In order to confirm the existence of such a problem, we used the technique of geographically weighted regressions. Interestingly, the only non-stationary parameter linked with quality of life is the one related to the community conditions of life, the variable with the unexpected negative sign. Various reasons have been proposed in the paper for this non-stationarity, one of them being the emergence of a new infrastructure which is slowly developing and changing the situation in the area, thus generating this non-stationarity.

In our view, the particular case of the province of Barcelona is interesting for several reasons. We see a wide area, in which different behaviours (production functions) exist, so that we cannot treat a previously administratively defined territory in a homogeneous manner. We also see how a change in the connectivity of the territory, such as the emergence of a new highway linking the central business area with municipalities that were previously separated by a natural barrier, can have dramatic influences on the territory. In our view, policy makers must respond quickly to these situations, as the newly connected zones may experience an intense growth in population which should be accompanied by a parallel growth in the provision of public services, in order to maintain the social equilibrium of the area.

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Table 1. Quality of Life Components and their variables

COMPOSITE QUALITY OF LIFE INDEX (CQLI)

CQLI = 1/3 IOP + 1/3 ISE + 1/3 CCL

IOP = Individual Opportunities for Progress

IOP = 0.30 WI + 0.25 LI + 0.175 ELI + 0.175 MotI + 0.10 DI

WI= Wealth Index

LI= Labour Index

ELI= Educational Level Index

MotI = Motorization Index

DI = Demographic Index

ISE = Index of Social Equilibrium

ISE = 0.2 HAI + 0.2 SII + 0.2 OCI + 0.2 CongI + 0.2 SOASI

HAI= HOUSING ACCESS INDEX

SII= SEX INEQUALITY INDEX

OCI= Obligatory Commuting Index

CongI= Congestion Index

SOASI= Social and Old Age Services Index

CCL = Community Conditions of Life

CCL = 0.15 HC + 0.065 PTI + 0.21 EFI + 0.21 HFI + 0.15 CEI + 0.15 CFMMI + 0.065 MFSI

HC= Housing Characteristics

PTI= Public Transport Index

EFI= Educational Facilities Index

HFI= Health Facilities Index

CEI= Climate and Environment Index

CFMMI= Cultural Facilities and Municipal Media Index

MFSI= Municipal Financial State Index

Source: ROYUELA *et al*., 2003.

Table 2. Descriptive statistics (1).

	Min	*Max*	*Average*	*Median*	*Std Dev*	*Kurtosis*	*Skewness*
POP	28	1643542	14828	1769	96284.46	263.91	15.70
Growth rate (1991-2000)	-54.1%	228.9%	22,95%	11,56%	0.35	7.34	2.20
FUNSUB	0	1	0.153	0	0.36	1.77	1.94
FUNSYS	0	1	0.076	0	0.27	8.32	3.20
TELEPH	125	1095.2	439.8	414.7	121.04	5.32	1.71
CQLI	76.34	117.31	100.29	100.90	6.02	1.29	-0.71
IOP	65.62	136.57	95.50	94.70	11.70	0.28	0.44
ISE	74.79	146.63	107.10	107.00	8.73	1.81	0.15
CCL	63.84	175.25	92.88	87.80	17.63	2.61	1.56
D_BCN	0.00	139.15	49.03	46.69	22.29	0.80	0.79
D_SYS	0.00	68.45	18.05	16.00	10.56	1.31	0.75
D_SUB	0.00	68.45	15.76	14.33	10.98	1.02	0.67

Note: FUNSYS: dummy variable for the 24 central cities of the province. FUNSUB: dummy variable for the 48 functional cities; TELEPH: installed telephone cells; POP: population of each municipality; CQLI Composite Quality of Life Index; IOP: Individual Opportunities for Progress; ISE: Index of Social Equilibrium; CCL: Community Conditions of Life. D_ means the distance measured in minutes from one city to Barcelona (D_BCN) or to the nearest city that can be considered the head of a System or Subsystem (D_SYS and D_SUB, respectively).

Table 3. Descriptive Statistics (2). Correlations

	POP	Growth rate (1991-2000)	FUNSUB	FUNSYS	TELEPH	CQLI	IOP	ISE	CCL	D_ BCN	D_ SYS
Growth rate (1991-2000)	-0.092										
FUNSUB	0.299	-0.160									
FUNSYS	0.369	-0.150	0.677								
TELEPH	0.045	0.545	-0.061	-0.017							
CQLI	-0.008	0.315	-0.068	-0.039	0.172						
IOP	0.059	0.445	0.069	0.038	0.359	0.623					
ISE	-0.137	0.290	-0.039	-0.020	0.070	0.719	0.171				
CCL	0.064	-0.269	-0.196	-0.115	-0.193	0.381	-0.221	0.057			
D_BCN	-0.213	-0.247	-0.370	-0.235	-0.196	-0.344	-0.576	-0.147	0.235		
D_SYS	-0.207	-0.101	-0.481	-0.493	-0.018	-0.320	-0.333	-0.228	0.060	0.751	
D_SUB	-0.193	-0.055	-0.611	-0.414	0.011	-0.321	-0.336	-0.224	0.059	0.772	0.923

See foot note from Table 2.

Table 4. Estimates of equation (3)

	(a)			(b)			(c)			(d)		
	Estimate	t - stat.	Spatial test (*)	Estimate	t - stat.	Spatial test	Estimate	t - stat.	Spatial test	Estimate	t - stat.	Spatial test
Intercept	-7.563	-5.430	0.01	-7.426	-5.504	0.00	-5.988	-4.219	0.14	-6.001	-4.374	0.08
ln POB	-0.064	-3.971	0.29	-0.066	-4.475	0.31	-0.064	-4.172	0.22	-0.069	-4.897	0.14
FUNSYS	-0.491	-1.984	0.22	-0.339	-2.335	0.43	-0.426	-1.869	0.14	-0.305	-2.269	0.15
FUNSUB	0.169	0.730	0.29				0.122	0.574	0.43			
ln TELEPH	0.590	8.848	0.01	0.594	8.957	0.00	0.479	7.458	0.04	0.484	7.572	0.04
ln DBCN	-0.148	-2.922	0.01	-0.142	-2.841	0.00	-0.114	-2.136	0.25	-0.108	-2.060	0.17
ln DSIS	-0.164	-1.790	0.19	-0.104	-2.037	0.12	-0.144	-1.702	0.09	-0.088	-1.859	0.04
ln DSUB	0.072	0.794	0.42				0.067	0.801	0.37			
ln CQLI	1.204	4.069	0.15	1.172	4.126	0.06						
ln IOP							0.565	3.548	0.20	0.562	3.557	0.13
ln ISE							1.143	5.733	0.24	1.144	5.815	0.14
ln CCL							-0.753	-4.099	0.00	-0.746	-4.150	0.00
	Global	GWR		Global	GWR		Global	GWR		Global	GWR	
AIC	104.62	65.61		101.03	45.15		54.85	5.09		51.59	-16.64	
R2	0.385	0.568		0.383	0.580		0.482	0.668		0.480	0.679	
adj-R2	0.367	0.506		0.369	0.528		0.463	0.609		0.465	0.627	
	ANOVA	DF	F test	ANOVA	DF	F test	ANOVA	DF	F test	ANOVA	DF	F test
OLS Residuals	24.1	9	3.839	24.1	7	4.678	20.3	11	4.087	20.3	9	4.855
GWR Improvement	7.2	30.52		7.7	28.1		7.3	36.8		7.8	34.65	
GWR Residuals	16.9	275.48		16.4	279.9		13	267.21		12.6	271.35	

(*) p-values associated with the spatial stationarity test

Figure 1. Map of Population Growth Rate. 1991-2000.

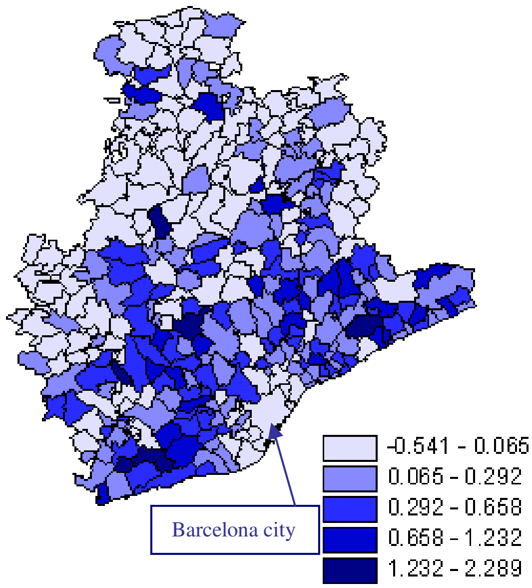


Figure 2. Map of Population. (ln POP) 1991.

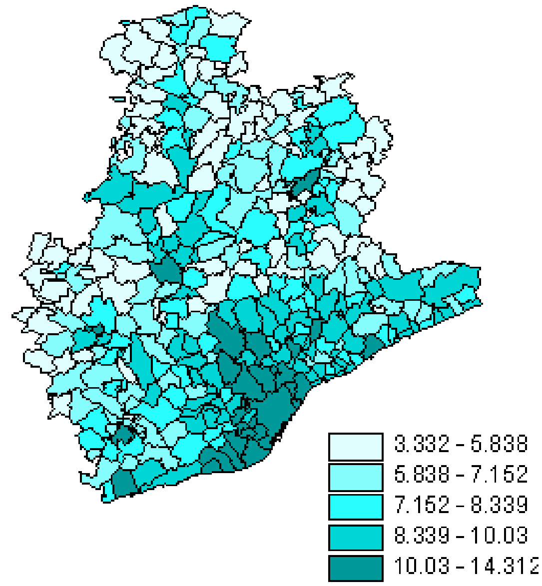


Figure 3. Map of the Composite Quality of Life Index (ln CQLI). 1991.

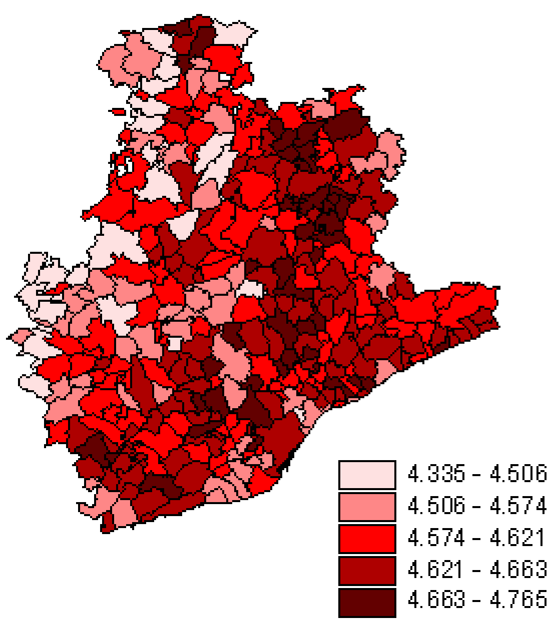


Figure 4. Map of Individual Opportunities for Progress (ln IOP). 1991.

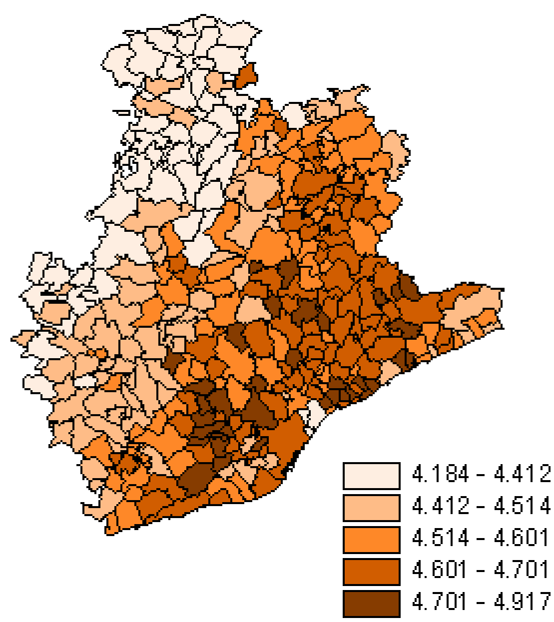


Figure 5. Map of the Index of Social Equilibrium (ln ISE). 1991.

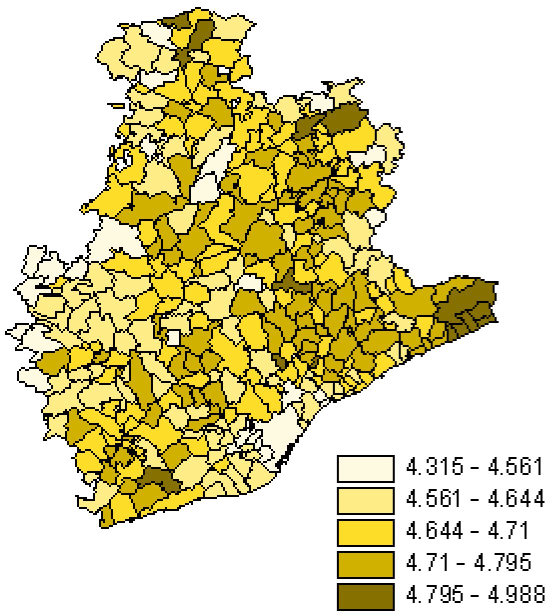


Figure 6. Map of the Community Conditions of Life (ln CCL). 1991.

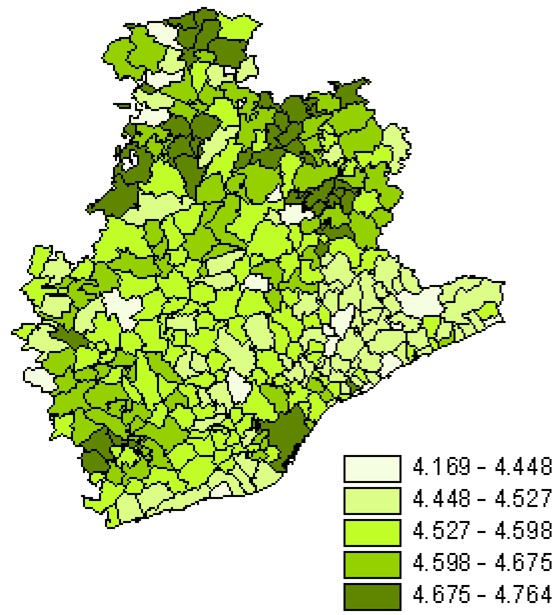


Figure 7a. Map of the network economies (LTELEPH) parameter. Model (b).

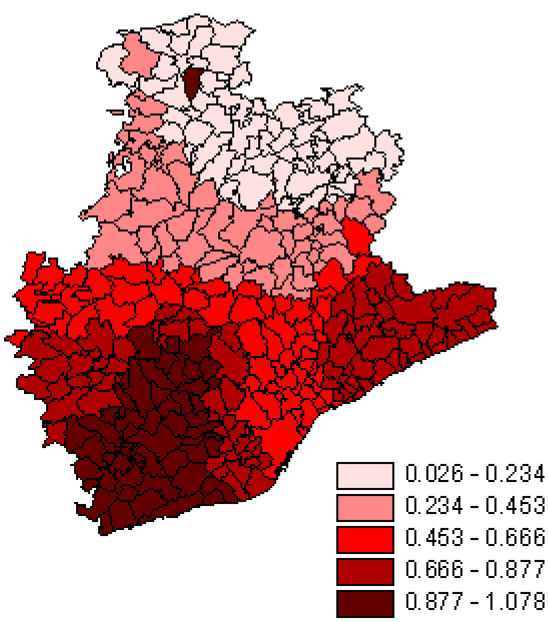


Figure 7b. Map of the network economies (LTELEPH) t-statistic. Model (b).

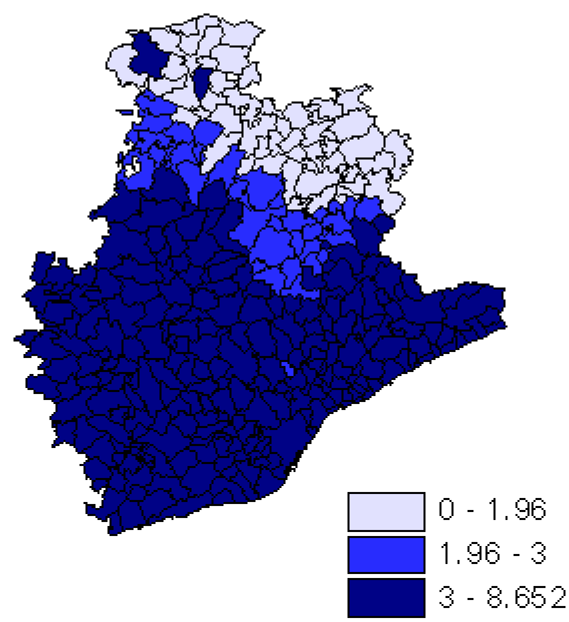


Figure 8a. Map of the distance to Barcelona (ln DBCN) parameter. Model (b).

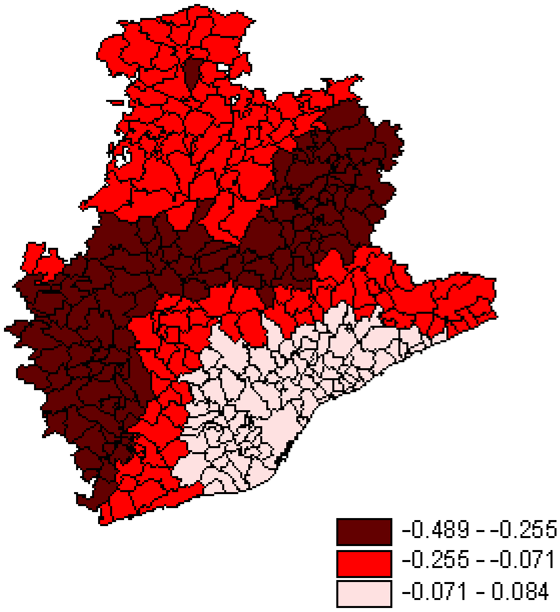


Figure 8b. Map of the distance to Barcelona (ln DBCN) t-statistic. Model (b).

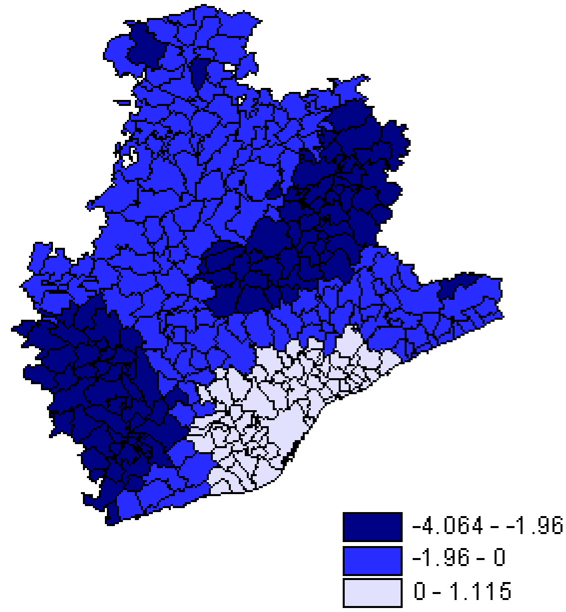


Figure 9a. Map of quality of life (ln CQLI) parameter. Model (b).

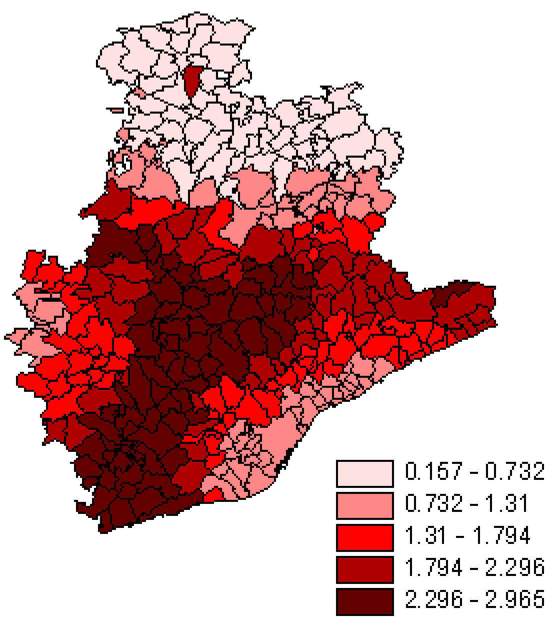


Figure 9b. Map of quality of life (ln CQLI) t-statistic. Model (b).

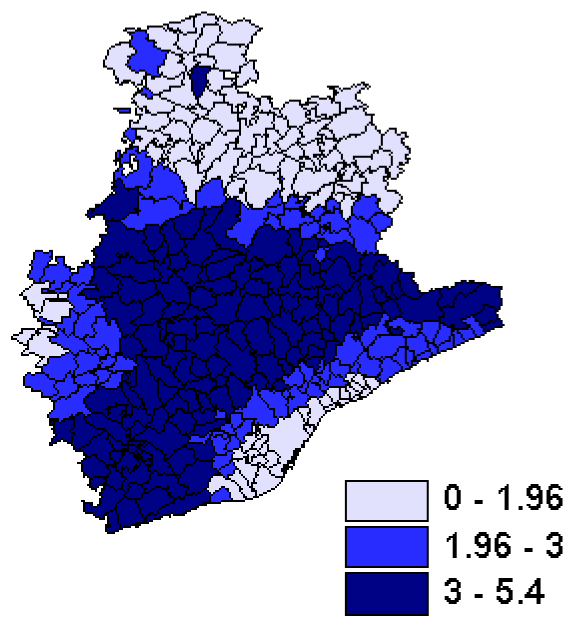


Figure 10a. Map of Community Conditions of Life (ln CCL) parameter. Model (d).

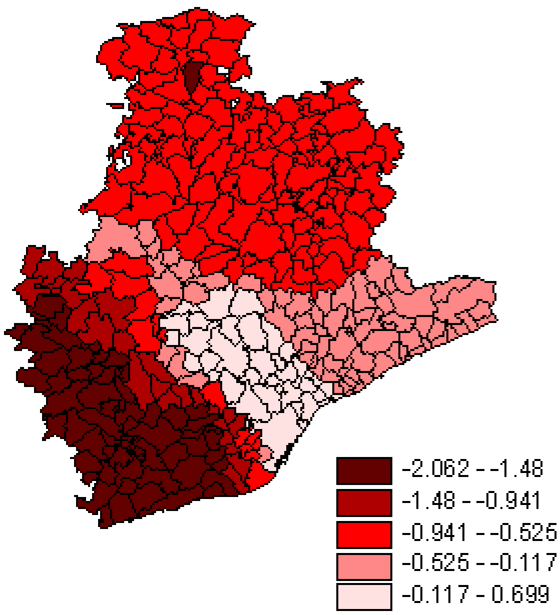
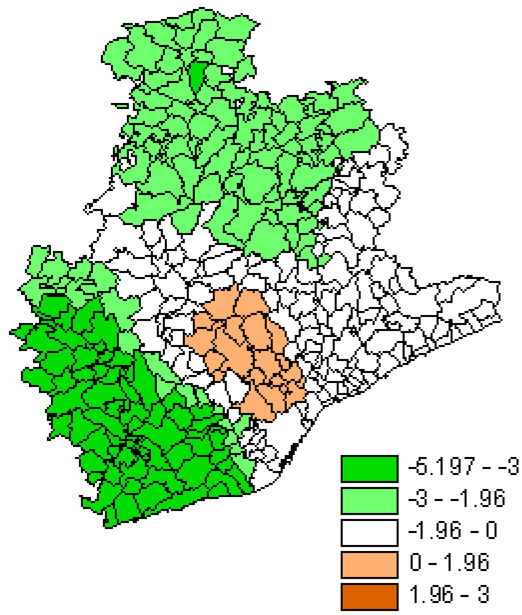


Figure 10b. Map of Community Conditions of Life (ln CCL) t-statistic. Model (d).



Notes

[1] Besides the factors used to find differences between areas, we can also expect to find spatial differences within a city. Some of them can arise due to the classical processes driving to segregation (see VARGAS and ROYUELA, 2007, for a review), while others can be due to the existence of housing submarkets. Regarding the latter, in the early urban economic literature of the 1950s and 60s, and in the long-run equilibrium models the city is treated as one entity and housing as a homogeneous commodity demanded in it. Different preferences for location and housing size and in households' ability to pay indicate segmentation in the urban housing market. From a supply point of view STRAZHEIM, 1975, highlights the heterogeneous and fixed nature of housing as a commodity, and proposes the treatment of urban space in discrete areas. Thus, the housing market is both spatially and sectorally complex, and an imperfect market with high probability of short-run disequilibria. But also in the long run, the lengthy adjustment lags on both the supply and the demand side mean that the housing market hardly ever adjusts fully and is continuously on a dynamic path towards equilibrium WATKINS, 2001.

[2] Municipalities are the smallest official territorial division in Spain, and correspond to NUTS V in the European administrative classification. In 2006, the 44,708,964 Spanish inhabitants lived in 8,110 municipalities. In section 4 we discuss the election of the municipalities as the basic unit of analysis.

[3] For a review of the connections between quality of life and urban economics see LAMBIRI *et al*., 2007.

[4] As EVANS, 1990, shows, migrations can occur even if no quality of life differentials are present between locations due to, among other reasons, the existence of consistent patterns over the life cycle. Consequently, although not included in the model, we understand that individual/household circumstances are important in defining QoL or aspirational amenities, and that they may vary over the life course.

[5] In MUÑIZ *et al*., 2003, the Barcelona area was defined as a Mediterranean polycentric city, where the polycentricity is derived from the large urban centre expanded into its commuting area, incorporating medium-sized cities that had previously been self-sufficient.

[6] In fact, CAPELLO and CAMAGNI, 2000, discuss how the lack of information on the flows of interaction between their sample cities (duration of phone calls or number of phone calls) obliged them to include a variable that represented the number of telephone subscribers. We therefore understand that, although this variable may no longer be appropriate, for the considered period it can be seen as a good indicator of the network paradigm. In addition, we use the information for 1996 as a proxy for the 1991 data due to the lack of available data for this year.

[7] We used more than 500 basic variables, referring to all 314 municipalities and to different time periods between 1991 and 2000. These figures indicate the size of the database.

[8] In the aforementioned study, a weighted (*a priori*) arithmetic average index of partial indicators is developed, which expresses the relative standardised position of each local territory, having combined the variability of all variables with a Paasche-type temporal aggregation.

[9] As in DREWNOWSKI, 1974.

[10] They also provide software for computing spatial analysis. GWR release 3 is the last version available at the time of writing this article.